XIII.

DISINFECTION OF DWELLINGS BY MEANS OF SULPHUR DIOXIDE.

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Within the past few years numerous experiments have been made by biologists with sulphur dioxide. They have failed in numerous instances to disinfect artificially infected rags and other material subjected to its influence.

These experiments have led biologists to pronounce sulphur dioxide unreliable in its action upon the contagion of disease.

I have had, in my official position, a wide experience with sulphur dioxide as a disinfectant, and I have been led to the conclusion that it is a thorough and an almost perfect destroyer of the infective matter of the acute exanthemata and diphtheria.

The facts that I will place before you in this short paper do not, I am aware, prove perfeetly and beyond doubt that SO_2 is an absolutely reliable disinfectant. They seem to me to be strong circumstantial evidence in its favor, and I present them as such.

The Disinfecting Corps of the Health Department of the city of New York, during the years 1887 to October 1, 1889, fumigated by means of SO_2 generated from burning sulphur nearly every room in tenement-houses in our city that had contained cases of small-pox, scarlet-fever, diphtheria, or measles. I say *nearly* every case. The aim of the department was to have the rooms in every case fumigated; but the corps was a large one, and occasionally a man was found derelict in his duty and had to be discharged, so that wilful neglect in a few instances caused some cases to be neglected. The method of using the sulphur was substantially in accordance with the rules laid down by the Committee on Disinfection of this Association. The sulphur was placed in a shallow iron basin, which was supported in a suitable tub containing water. Ignition was effected by means of about four ounces of alcohol poured over it.

I will take each disease separately, and by comparing the total number of cases with the number of cases that recurred, the recurrence of which could be attributed to infection left after fumigation, show the efficiency of the agent in question.

In the year October 1, 1887, to October 1, 1888, we had in our city 321 cases of small-pox. These cases occurred in 227 houses. Eighty-two of these cases were contracted from exposure to some of the 239 original cases; nearly all of which were in their turn traced to direct exposure to

other cases, either out of the city or in it. Nine cases could not be traced to their cause. They were probably due to contagion from some mild, unrecognized case that travelled about spreading the disease. Not one single case of the disease was developed from the clothing or from the rooms in which these cases were, and from which they were removed to the hospital for small-pox. No other precaution was taken in the case of the rooms and clothing than that of fumigation by SO_2 in proportion of three pounds of sulphur to each one thousand cubic feet of air space for at least two hours. This, however, was done in a most conscientious and careful manner, immediately after the removal of each case.

Again: In the year October 1, 1888, to October 1, 1889, seven cases of small-pox occurred in five houses. All were traced to their cause, which was found to be direct exposure to a previous case. Not a single case occurred from infection left in the room or clothing by any of these cases.

We always permit occupancy of rooms that have contained small-pox patients as soon as they have been fumigated.

In this connection, the effect of fumigation by SO_2 upon vaccine virus is interesting. On October 2, 1889, ten quill slips charged with vaccine virus taken from a lot charged equally from the same animal, were exposed in a room 15x15x8, to the fumes of one pound of sulphur for two hours. Each slip was then used to vaccinate a child that had never before developed vaccinia. All failed to effect any result. Ten other points from the same lot were effective upon all but one child of ten other primary cases. This child evidently had considerable resistance against vaccinia, as it only took after the third trial.

For the purposes of this paper, the same comparison of primary cases with secondary cases as I have stated was done in cases of small-pox, was made of scarlet-fever, diphtheria, and measles in the following streets, which were chosen as examples of the worst, from a sanitary standpoint, in the city: Division street, Washington street, Rivington street, Mulberry street, West 16th street, West 12th street, East 7th street, East 12th street, East 46th street, East 102d street, East 113th street.

Let us first take scarlet-fever. From January 1, 1888, to October 1, 1889, 626 cases occurred in the above named streets in 453 houses, and 135 secondary cases occurred in 87 houses.

Of the 135 secondary cases, 106 occurred within five weeks of the beginning of the primary cases, to the direct contagion of which they were presumably due. This leaves but 29 cases out of a total of 626 that were possibly due to contagion left in rooms and apartments after disinfection by means of sulphur dioxide after the termination of each case.

During the same period (January 1, 1889, to October 1, 1889), 515 cases of diphtheria occurred in 382 houses, and 114 secondary cases occurred in eighty of these houses. Seventy-nine of the secondary cases occurred within four weeks of the beginning of the primary cases, to the direct contagion of which they were, therefore, presumably due. This

leaves only 35 cases out of a total of 515 that were possibly due to contagion of diphtheria left in rooms and apartments after disinfection by means of sulphur dioxide after the termination of each case.

In the case of measles, 557 cases occurred in 361 houses, and 163 secondary cases occurred in 95 of these houses. One hundred and twenty-two of the secondary cases occurred within five weeks of the beginning of the primary cases, to the direct contagion of which they were, therefore, presumably due. This leaves only 41 cases out of a total of 557 that were possibly due to contagion of measles left on the premises after disinfection by means of sulphur dioxide performed after the termination of each case.

These figures are interesting when carefully considered, and they show the relative efficiency of sulphur dioxide in the case of each of the diseases. The gas is most destructive to the contagion of small-pox and next to that of scarlatina.

In the case of measles, we have an explanation of the comparatively large number of secondary cases. The disease is a mild one, speaking comparatively, and many cases are not properly isolated in the homes of the poor; consequently, rooms and material are infected outside of the apartment in which the patient belongs, and which the disinfector fumigates. Moreover, during the past two years we have had so many cases of contagious diseases, that measles have not received the attention of our inspectors and disinfectors that should have been given it, scarlet-fever and diphtheria taking most of the time of the men.

The contagion of diptheria would, from our statistics, seem to resist the action of sulphur dioxide most, and to be the most difficult to destroy. This is in my opinion due to the manner of its infection. The other three diseases infect a room by means of the medium of the air, the contagion being exhaled or given off from the body and deposited evenly over the surfaces exposed to the infected air. In diphtheria membrane and secretions are infected, and the contagion is protected by being surrounded by a protecting medium into which sulphur dioxide cannot easily penetrate. This is probably the reason why biological experiments with SO_2 are not satisfactory. It is impossible to imitate in the laboratory nature's method of infection. The power of penetration of SO_2 into the culture medium cannot be very great. The medium must to an extent protect the culture within it, so that only those cultures are affected that are on the surface of the medium. Just as diphtheritic secretions protect diphtheritic contagion, so do culture mediums to a less extent perhaps protect cultures.

In nature's method of infection, the infected air is carried by draughts and air currents into cracks and corners accessible only to a gas liberated under much the same conditions as the contagion.

CONCLUSIONS.

It would seem that the proper and most practical method of disinfection of dwellings after the occurrence in them of exanthemata and of

diphtheria, is by means of sulphur dioxide, and that all clothing, bedding, etc., used in direct contact with the patient, should be removed to a disinfecting station, properly equipped, and there subjected to heat of sufficient intensity to destroy all contagious matter. This in future will, I believe, be the method pursued by the health department of the city of New York.

ADDENDA.

The following table shows the details of the cases I have given. It will be seen that a large number of the secondary cases occurred three months and over from the beginning of the primary case.

Many of these secondary cases occurred in other apartments in the same house as the primary case, but were probably not due to contagion from it. It is impossible, however, to say that they were not caused by the first case. I have counted them among the cases possibly due to primary cases. Some of these occurred nearly a year after the first case.

	Total number of cases in streets named.	Number of houses containing cases.	Number of houses containing secondary cases.	Number of secondary cases.	Number of secondary cases in same family.	Number of times two cases reported from house in same day.	Number of times three or more reported from one house same day.	Cases occurring one week or less after primary case.	Two weeks or less.	Three weeks or less.	Four weeks or less.	Five weeks or less.	Six weeks or less.	Three months or more.
DIPHTHERIA.														
Jan. 1, 1888, to Oct. 1, 1889	237	180	37	50	15	7	2	24	8	7	1	0	2	8
Oct. 1, 1888, to Oct. 1, 1889	278	202	43	64	18	11	3	26	7	5	1	2	3	20
Total	515	382	80	114	33	18	5	50	15	12	2	2	5	28
SCARLET-FEVER.														
Jan. 1, 1888, to Oct. 1, 1888	253	191	36	47	18	11	4	25	8	6	3	2	0	3
Oct. 1, 1888, to Oct. 1, 1889	373	262	51	88	27	25	3	36	13	10	1	2	9	17
Total	626	453	87	135	45	36	7	61	21	16	4	4	9	20
MEASLES.														
Jan. 1, 1888, to Oct. 1, 1888	302	183	54	102	23	27	2	18	38	13	2	1	14	16
Oct. 1, 1888, to Oct. 1, 1889	255	178	41	61	14	13	6	17	23	8	1	1	2	9
Total	557	361	95	163	37	40	8	35	61	21	3	2	16	25